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Title: *Heliospheric Transport Across Magnetic Fields*

Cluster: *Cross-Theme Theory and Data Analysis/SECTP*

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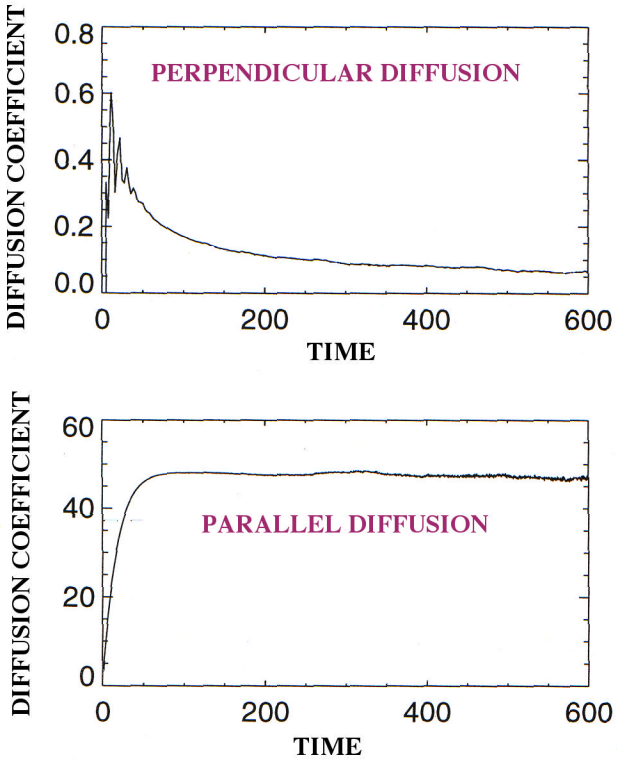
- **Diffusion Across Interplanetary Magnetic Field Inhibited by Parallel Diffusion**

Transport of energetic particles through the heliosphere depends on diffusion (due to scattering by magnetic irregularities) both along and across the mean interplanetary magnetic field lines. In the past, diffusion perpendicular to and parallel to the average **B** direction has been theoretically described typically as independent of one another, but problems were encountered in interpreting observations with this assumption. Recent computations by the Bartol/University of Delaware SEC Theory Program group show that this may not always be appropriate. When the transverse structure of the magnetic field is not too strong, they found that parallel scattering "undoes" the perpendicular diffusion. Hence the diffusion along the average **B** affects the perpendicular transport in a nonlinear manner.

This result provides a new paradigm for further studies of key Sun-to-Earth coupling processes highlighted in NASA's SEC Roadmap. The collisionless spatial transport of energetic charged particles is a fundamental process in space and astrophysical plasma physics, entering in an essential way into cosmic ray modulation, solar energetic particle transport, shock acceleration and wave particle interactions, as well as energy confinement in laboratory plasmas.



A running time test particle simulation. When parallel diffusion set in, the perpendicular diffusion coefficient was suppressed.

(Diffusion coefficients and time units are defined using correlation length of B turbulence and plasma speeds.)

Reference: "Subdiffusive transport of charged particles perpendicular to the large scale magnetic field", G. Qin, W. H. Matthaeus and J . W. Bieber, Geophys. Res. Lett., in press, 2002.